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BOF
Bridge Owners' Forum

Bridge strikes by large vessels

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Low probability high consequence

"While the probability of a vessel colliding with a bridge or critical superstructure is relatively low, the potential consequences of such an event are extraordinarily serious."

CROSS Alert

CROSS & CHIRP Safety Alert

Bridge strikes by large vessels

Region: Global Published: November 2024

Figure 1: Aftermath of the collapse of the Francis Scott Key Bridge in Baltimore, March 2024

Who should read this alert?

This Alert is primarily aimed at owners of existing bridge structures and port authorities who manage the passage of vessels in waterways where there are large bridges. It is also relevant to those tasked with the design of new bridge structures.

A bridge strike could cause major disruption to societal infrastructure. It is important that local and national authorities read this Alert so that they are aware of the potential risks and can put contingency plans in place.

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Bridge strikes by large vessels

CROSS Safety Alert

Who should read this?

- Designers of new bridges
- Those responsible for existing bridge structures
- Port authorities
- Ship owners/operators
- Harbour masters

CHIRP

CHIRP Maritime
***Improving safety at sea** worldwide*

Our goal is to improve safety for everyone in the maritime industry, one report at a time. Our Maritime Programme provides an independent, confidential incident and near-miss reporting system for people to share their safety concerns.

Historical

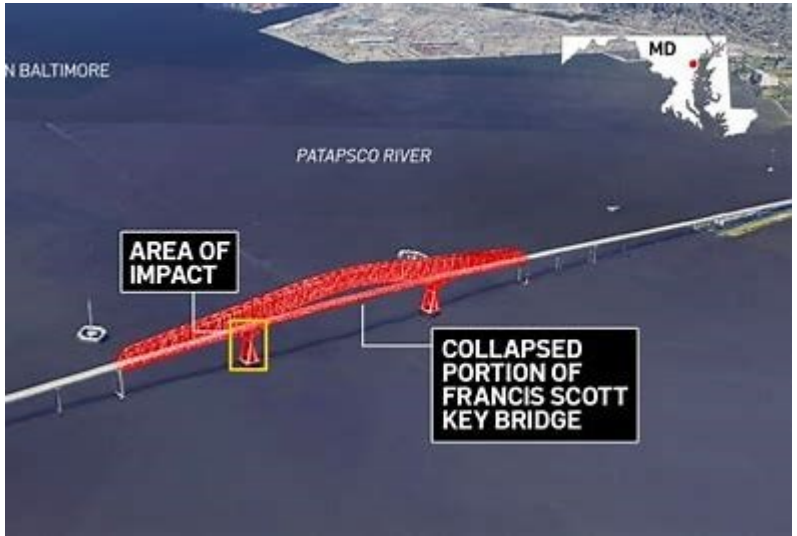
- **Sunshine Skyway Bridge** in 1980 in Florida when a bulk carrier ploughed into a pier resulting in total collapse of several spans and thirty-five fatalities.
- **The Almo Bridge** in Sweden collapsed the same year with no casualties from the strike but eight people died from driving over the collapsed edge.
- In 1983, the greatest loss of life occurred when 172 people were killed on the **River Volga in Russia** when a passenger ship attempted to pass under a low railway bridge with most of the casualties occurring on the ship itself.

The Almo bridge

Pont de Sully Paris

- *Built 1876*
- *January 31, 2024, 6 months before the Olympics, a cruise ship hit the central span*
- *Repairs led by Cerema and included Freyssinet and Chantiers Modernes Construction*
- *Re-opened 5 July 2024*
- *Opening ceremony 26 July*

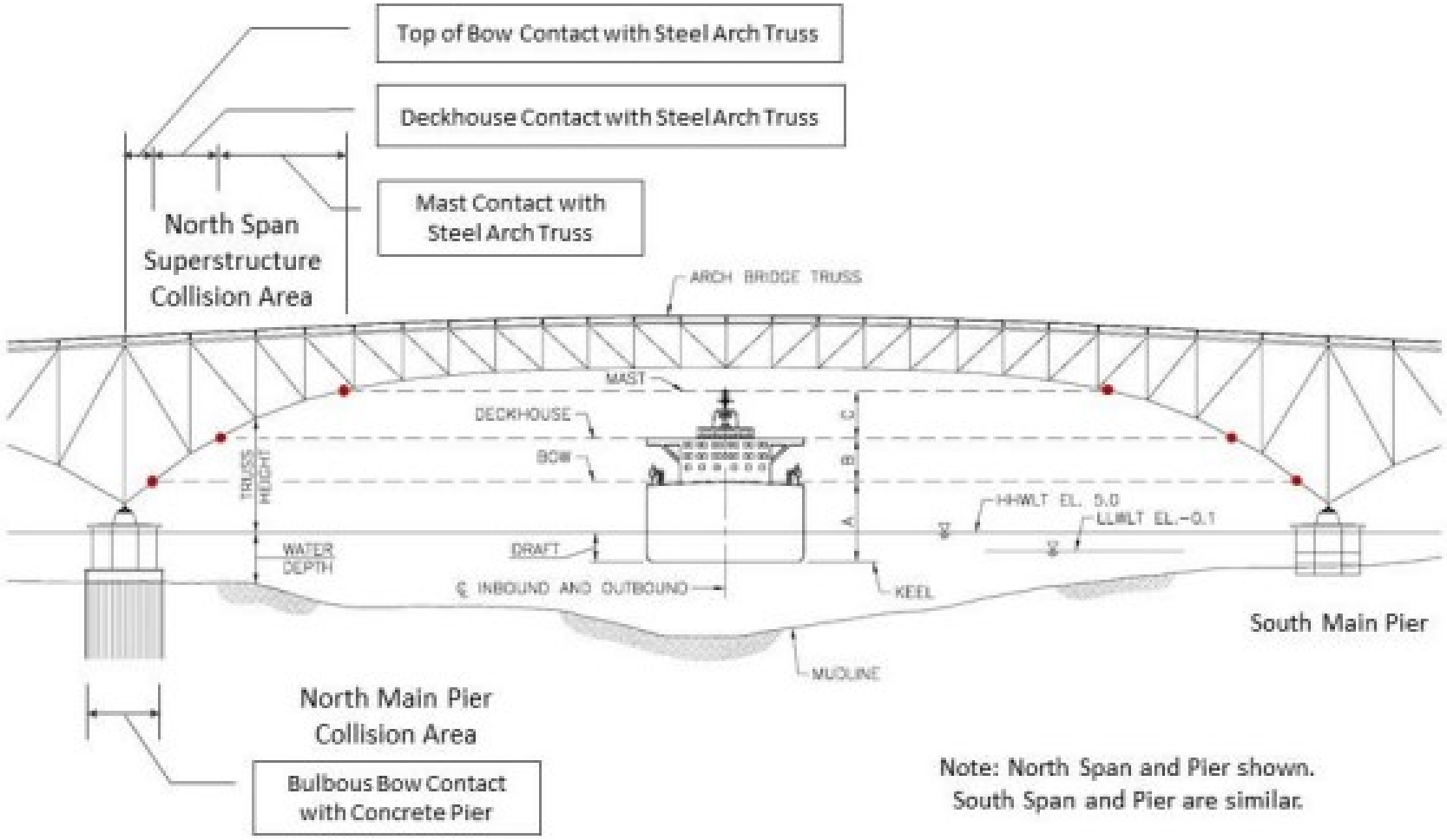
Francis Scott Key bridge



Location


PATHWAY OF CARGO SHIP DALI
The Dali began moving at approximately 12:51 a.m. and made its way out of the port, colliding with the Francis Scott Key Bridge at approximately 1:20 a.m.
Status Changed: under way using engine, 12:51 a.m.
Speed: 3 kn
BALTIMORE
Started moving, 12:51 a.m.
Speed: 3.2 kn
Port departure, 1:18 a.m.
Speed: 7 kn
Struck bridge, around 1:30 a.m.
Francis Scott Key Bridge

Potential impact points



Design guidance for bridges

- American Association of State Highway and Transportation Officials (AASHTO) produced the "*Guide Specification and Commentary for Vessel Collision Design of Highway Bridges*" current 2009 version is compatible with the AASHTO 2014 LRFD
- In Europe, the forces for ship impact are contained within the Eurocodes
- "*Ship Collision with Bridges*", IABSE (1993) currently being updated for completion in 2028
- *"Design of bridges against ship collisions"* Pederson, Chen and Zu (2020)

Overall risks

- Growth in ship sizes and changes in operational methods
- Ageing infrastructure
- The vessel goes off course near the bridge or substructures

- The off-course vessel hits a part of the bridge
- The impacted bridge element fails
- Protection factors, like the bridge's location and surrounding features are important

Risk factors for ships

- **Maintenance**
  - The highest risk for bridge contact occurs when there is a total loss of propulsion or electrical power.
- **Crew Experience**
  - A well-organized crew that communicates effectively and is well-practised in emergency preparedness significantly reduces the risk of breakdowns and the recovery from one.
- **Environmental Factors**
  - The new MARPOL (International Convention for the Prevention of Pollution from Ships) regulations on sulphur emissions require ships to carry multiple fuels and switch between them depending on location.
- **Passage Planning and Ship Traffic Management**
  - Passage planning for river transit under a bridge should be coordinated with the pilotage authority.

Changes over time

- changes in shipping patterns and vessel sizes over time
- growing risk that the protective measures initially implemented to prevent ship impact during the design phase may become inadequate for larger ships
- ports and harbour authorities need to continuously review and assess changes in the traffic that passes under bridges to ensure safety using a periodic and formal risk assessment process
- just in time management limits the time available for proper ship preparation and maintenance, leading to potential readiness issues when arriving or departing on tight schedules.
- changes to a port's customers and the type of freight that is handled.

Contingency plans for bridge owners

- How would you know if a bridge was down?
- In the event of a strike, or a potential strike, immediately close the bridge
- Know which infrastructure facilities would be affected including road and/or railway lines and utilities
- Have communications protocols for informing asap all who would need to know
- Know who to contact at nearby ports and make sure that they know who to contact at bridge control
- Regularly review risk assessments to have a complete check list of what to do and by whom in the event of a strike

Recommendations

Bridge designers

- Carry out risk analyses of the effects of bridge strikes
- Consider climate change effects during the projected life of the structure
- Develop options for avoidance or protection

Bridge owners and operators

- Carry out periodic risk analyses taking account of changing circumstances
- Regular liaison with port authorities
- Regular liaison with utility providers who use the bridge

Port authorities

- Be mindful of changes to vessel operators, types of cargo, and climate change effects
- Regular liaison with bridge owners and operators on risks and contingency plans

Ship owners and operators

- Ensure proper maintenance of vessels and equipment for the avoidance of mechanical or navigational failure particularly when entering and leaving port
- Regular risk analyses of new and existing routes where vessels pass beneath bridges

Autonomous vessels

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